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ITC-Germany Visit

TARDEC

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

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Ground Vehicle Power and Mobility Overview
10 November 2011

Report Documentation Page

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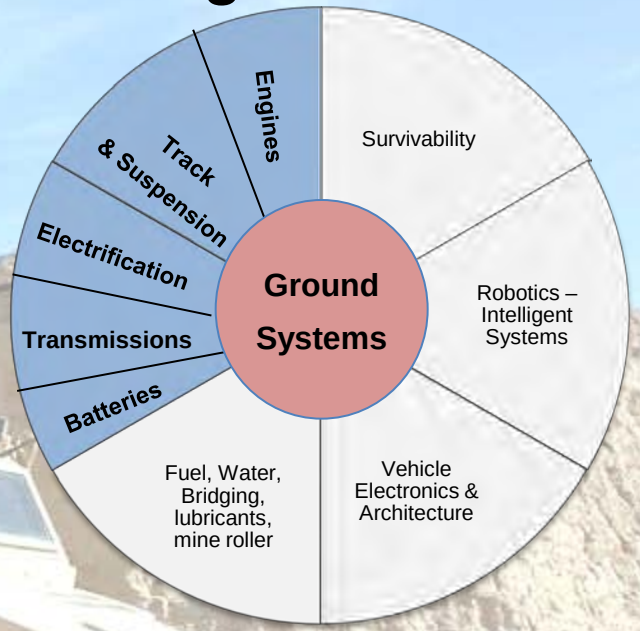
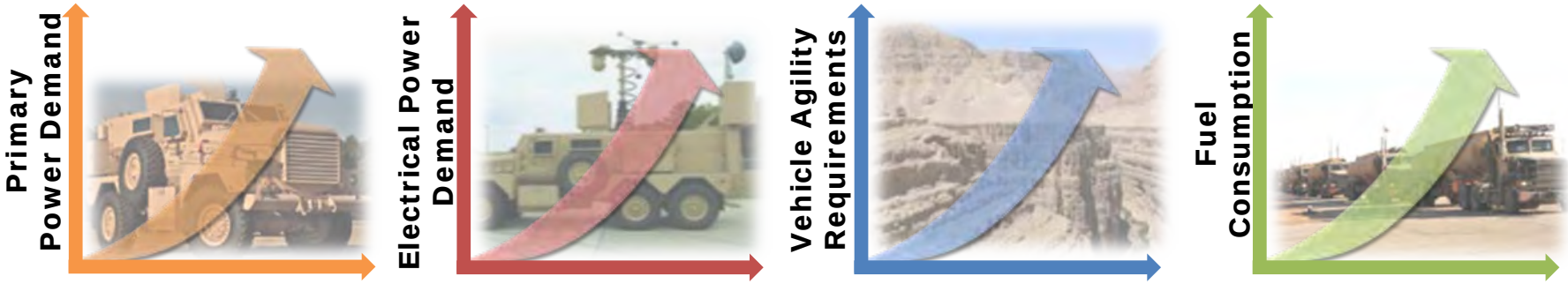
Vision: GVPM will be the DoD's first choice for ground systems power and mobility solutions



Mission: Research, develop and deliver ground systems power and mobility technology solutions to the current and future force

Selecting the Right Technologies to Meet the Challenges



Increasing demands, operational flexibility, and inter-relationships
Requires a Systems Engineering approach and investments in key technology areas

Propulsion & Thermal Management

Non-Prime Power Systems

Advanced Propulsion

Track & Suspension

Systems Level Analysis, Integration and Testing

S&T Vectors for Improving Operational Energy Efficiency

Operational Energy:

"energy required for training, moving, and sustaining military forces and weapons platforms for military operations."

2010 QDR

Pursue Operational Energy Efficiency by targeting the Army's Energy Security Goals

Reduced Adverse Impacts on the Environment

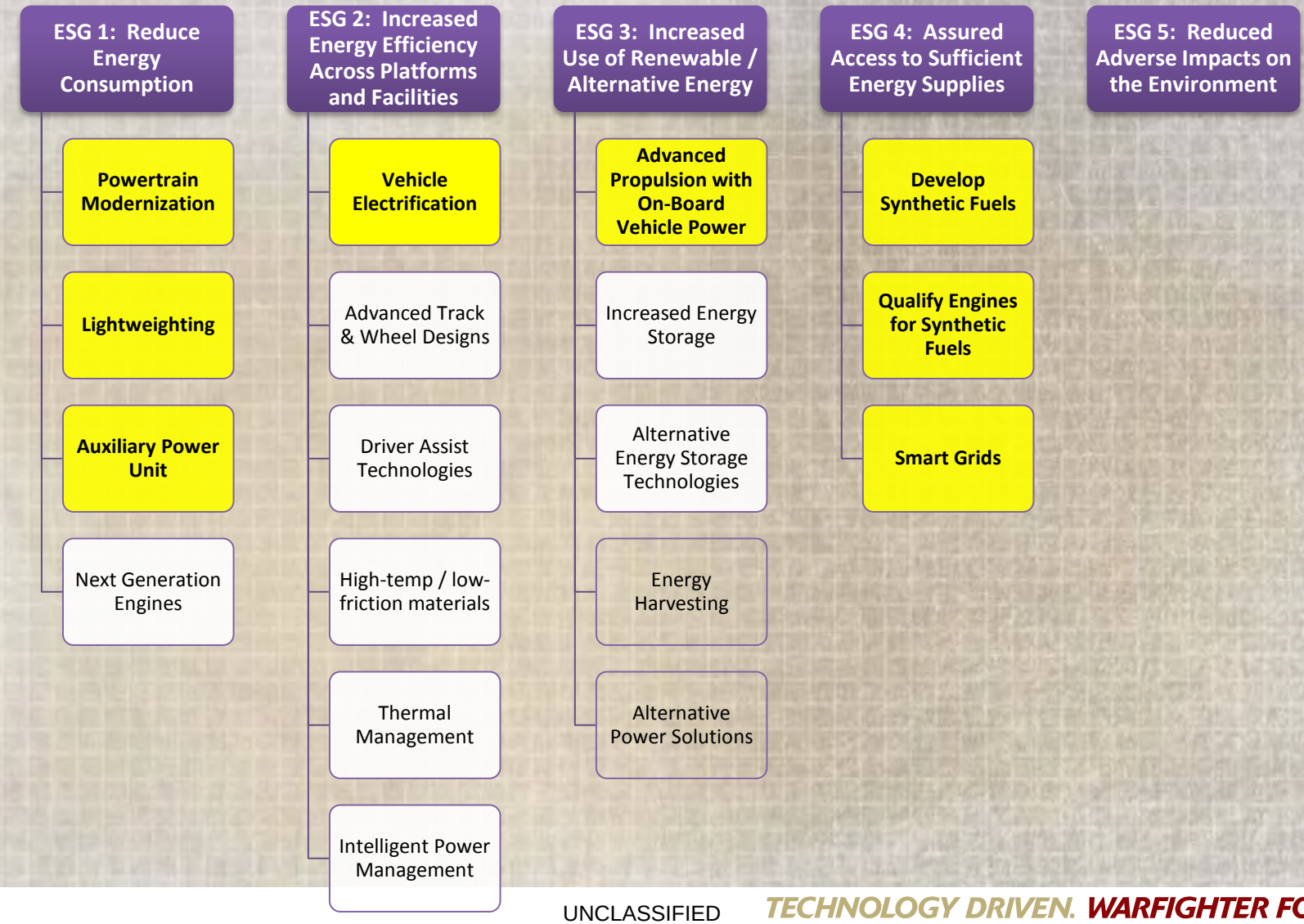
Assured Access to Sufficient Energy Supplies

Increased Use of Renewable / Alternative Energy

Increased Energy Efficiency Across Platforms and Facilities

Reduced Energy Consumption

Framework for Meeting Army Energy Security Goals



Operational Energy Focus

Why we need it…

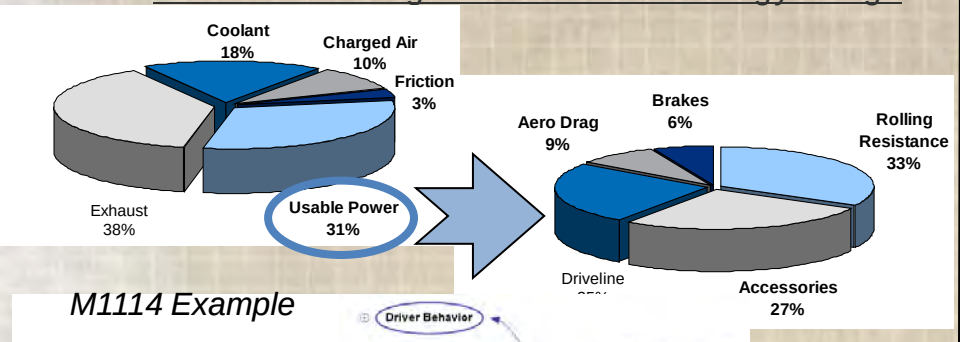
- 70-80% of convoys deliver fuel and water in a typical theater
- Fully burdened cost of fuel (FBCF) as high as $50 /gal in Afghanistan
- 18% of US casualties in OIF and OEF are related to ground resupply

What needs to be done…

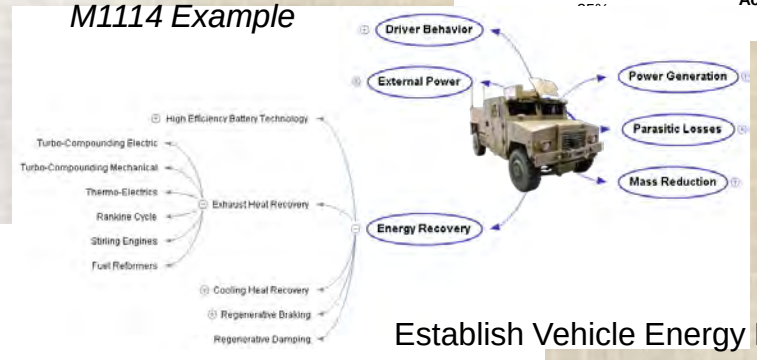
- Build Operational Energy into Army requirements and funding processes

What's required to enable…

Characterize Engine and Vehicle Energy Usage



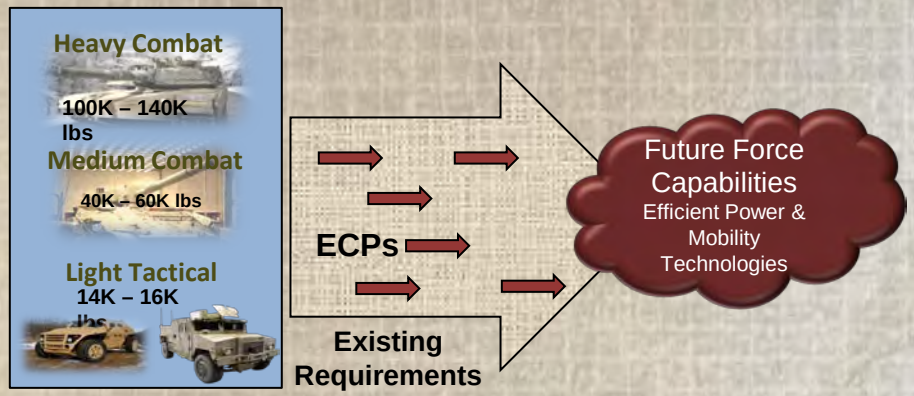
M1114 Example



Establish Vehicle Energy Baselines

- Duty cycles
- Basis of improvement strategy

Incorporate Operational Energy into Fleet Modernization Requirements



- Update Vehicle Requirements to drive improvements
  - Operational priorities
  - ECPs based on old requirements

GVPM Technology Taxonomy

Ground Vehicle Power and Energy Technology

Propulsion and Thermal Management

Diesel Engines

Turbine Engines

Transmissions

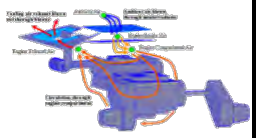
Advanced Radiators

Electrified Thermal Components

Advanced Electronics Cooling

Heat Recovery

Thermal Architectures



Non-Prime Power Systems

JP-8 Fuel Cell APU

Rotary Engine APU

Advanced Lithium Ion Batteries

Advanced Lead Acid Batteries

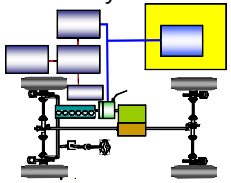
Capacitors

Li-Ion / Ultracap Hybrid Energy Storage

Advanced Propulsion

Integrated Starter Generator

Advanced Propulsion Systems



Traction Motor Testing

Advanced Propulsion Reliability Testing

High Temperature / Power SiC Power Electronics

Wide Band Gap Materials (SiC)

Track and Suspension

Track Systems

Suspension Systems

Electronic Stability Control

Track Elastomer Research

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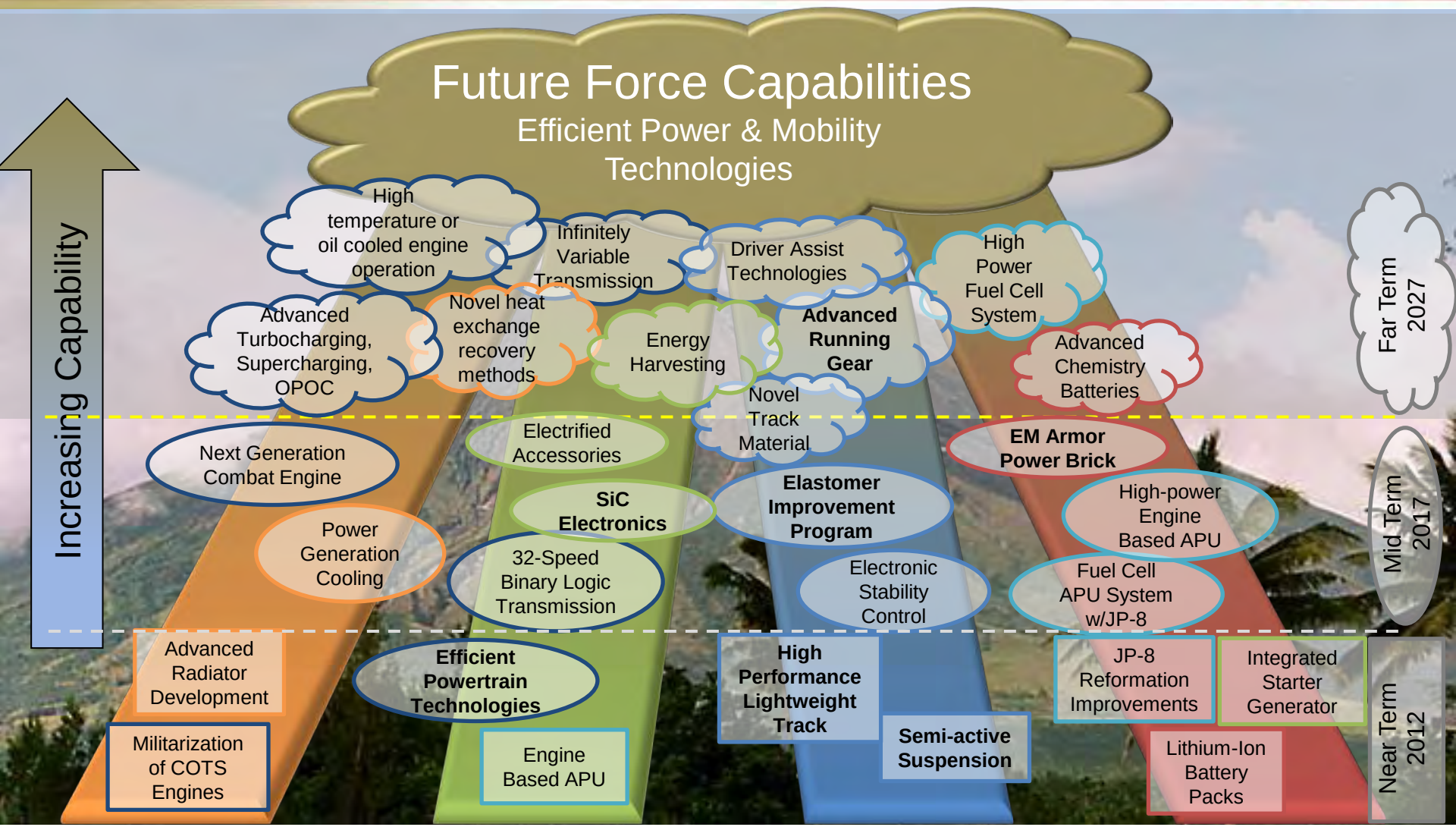
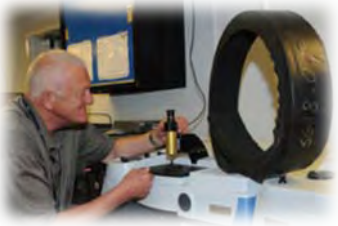
Capability Based Technology Strategy



GVPM Laboratory Overview

- **Propulsion Laboratory**
  - **Engine Dynamometer Test Cells**
  - **Power and Inertia Simulator (PAISI) Test Cell**
  - **Vehicle/transmission/drive axle Evaluation Test Cell**
  - **Single-cylinder Engine Research Test Cell**
  - **Engine Generator Test Lab**
- **Full Vehicle Environmental Test Cell**
- **Hybrid Electric Reconfigurable Moveable Integration Testbed (HERMIT)**
- **Electro-chemical Analysis and Research Lab (EARL)**
- **Battery Lab**
- **Air Flow/Cooling Lab**
- **Elastomer Lab**
- **Ground Systems Power & Energy Labs (GSPEL)**

Propulsion Lab



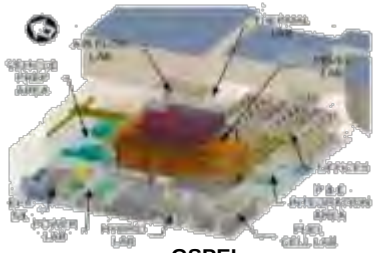
Elastomer Lab

Airflow/Cooling Lab

Battery Lab

HERMIT

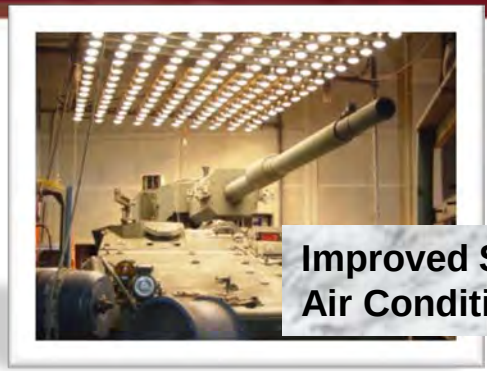
Environmental Test Cell



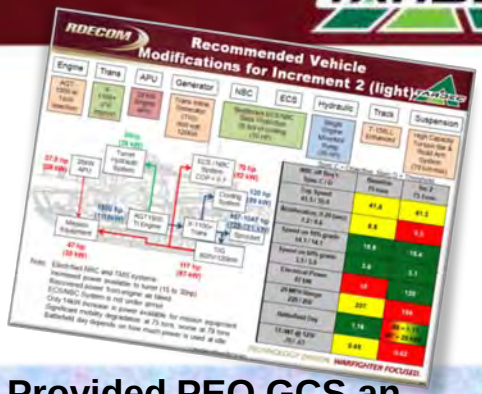
GSPEL

Recent GVPM Accomplishments

Developed methodology and tool for assessing Heavy Vehicle Road Damage



Improved Stryker Air Conditioning

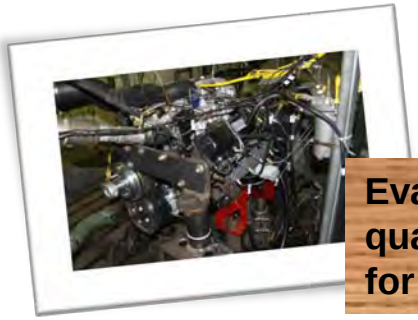


Provided PEO GCS an independent analysis of upgrade options for Abrams

Tested and redesigned cooling system for MRAP-ATV with Sparks II Mine Roller

Conducted PIM Full Load Cooling Tests

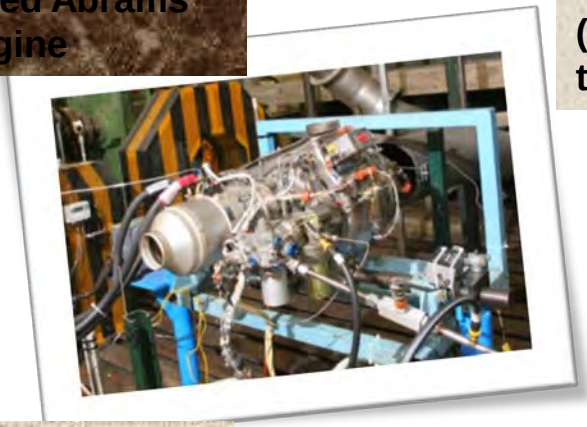
Tested and optimized MRAP Air Conditioning Design



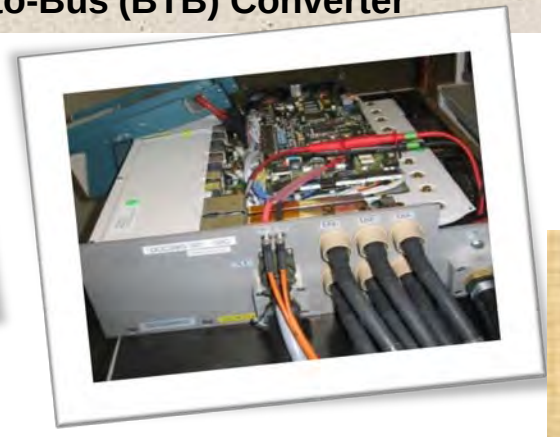
Evaluated & qualified 5 engines for Alternative Fuels

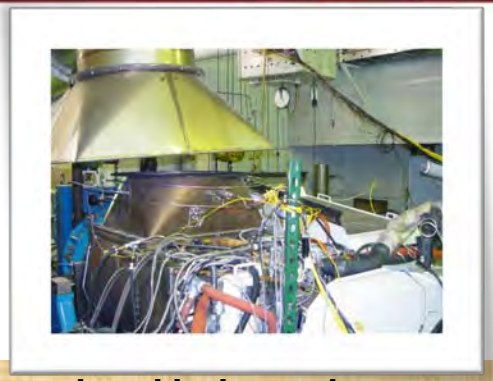
Recent GVPM Accomplishments

Developed Abrams APU Engine



Bench tested Silicon Carbide (SiC) 150 kW DC-DC Battery-to-Bus (BTB) Converter





Completed independent durability assessment of OEM improvements to AGT-1500 Turbine engine to support PM decision making

Conducted competitive runoff evaluations on Bridging Boat engine candidates

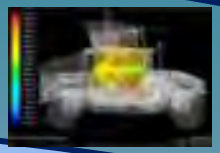
Developed a proof of concept 10 kW fuel reformer/fuel cell auxiliary power unit operating on JP8 fuel

Commissioned a new four-quadrant dynamometer for characterization and testing of electric machines, e.g. hybrid electric propulsion motors

It's all about...Supporting the Warfighter

Backup Slides

Laboratory Support Throughout the Ground Platform Lifecycle



Capability Gaps

Concepts

Platform Simulation

Component Development

Component Testing

Integrated Component Testing

Vehicle Integration

Vehicle Testing

Transition

Enabling Warfighter Capability Through Technology Development & Integration